

**DRAFT**

# ***Modular Concrete Bunker Indirect Fire Validation***



***Fort Polk, LA  
August 4<sup>th</sup> to 13<sup>th</sup>, 2004***

# **DRAF**Series 1 - Buried Emplacement



- **4' soil cover - sandy clay**
- **Experimental objectives:**
  - ✓ Evaluate constructability
  - ✓ Evaluate structural response to blast effects of 122mm rocket/155mm artillery



# DRAF Series 1 - Buried Emplacement



## Shot 1-1

- 12 lb C4 to simulate M107, 155mm artillery or 9M22Y, 122mm rocket
- Charge placed top-center of 6" walled barrel



- No effect on concrete section
- Crater dimensions:
  - ✓ diameter = 7'-8"
  - ✓ depth = 2'-2"

# **DRAF**Series 1 - Buried Emplacement



## **Shot 1-2**

- **12 lb C4 to simulate M107, 155mm artillery or 9M22Y, 122mm rocket**
- **Charge placed 3'-6" to side of 6" walled barrel**

- **No effect on concrete section**
- **Crater dimensions:**
  - ✓ **diameter = 7'-11"**



# **DRAF**Series 1 - Buried Emplacement



External Video



Internal Video

**Shot 1-2**



# DRAF Series 1 - Buried Emplacement



- No effect on concrete section
- Overturned Hesco retaining walls
- Clear egress remained at opposite end

## Shot 1-3

- 12 lb C4 to simulate M107, 155mm artillery or 9M22Y, 122mm rocket
- Charge placed top-center of entrance section



# **DRAF**Series 1 - Buried Emplacement



External Video



Internal Video

**Shot 1-3**



# DRAF Series 1 - Buried Emplacement



## Shot 1-4

- 20 lb C4 to simulate M795, 155mm artillery
- Charge placed top-center of 9" walled section

- Induced two flexural cracks in roof; crack widths approx. 1/16<sup>th</sup> inch
- No measurable permanent deflection in roof
- Crater dimensions:
  - ✓ diameter = 11'-6"



# **DRAF**Series 1 - Buried Emplacement



External Video



Internal Video



# **DRAF**Series 1 - Buried Emplacement

- Executed four experiments to validate structural response to blast effects of quick-fuzed 155mm artillery and 122mm rocket
- Explosive charge weights include 12 lb C4 and 20 lb C4
- Structure survived blast effects of all charges
- Viable ingress/egress was maintained in all experiments



# **DRAFT** Series 2 - Line-of-Fire Denial



**In-theatre**

- Evaluated two bunkers:
  - One recently observed in-theatre with open ends constructed from jersey barriers, and
  - One constructed with a modified entrance intended to deny line-of-fire

- Experimental objectives:

- ✓ Validate the level of protection increase provided by a modified entrance section which denies fragment line-of-fire



**Modified  
Entrance**

# **DRAFT** Series 2 - Line-of-Fire Denial



- Foam/plywood witness panel hit hundreds of times
- Witness panel plywood perforated 52 times
- No hits observed in witness panel within 19" of inside wall

## **Shot 2-1**

- Weapon placed 10' from corner of bunker
- Simulating contact detonation on ground
- Oriented at 10° from normal impact



# **DRAFT** Series 2 - Line-of-Fire Denial



## **Shot 2-2**

- Weapon placed 4'-10" above ground, in-line with center of structure
  - Simulating proximity fuse
  - Oriented at 10° from



- Foam/plywood witness panel hit hundreds of times
- Witness panel plywood perforated 221 times
- No hits observed in witness panel within 14" of ground

# **DRAFT** Series 2 - Line-of-Fire Denial



## **Shot 2-3**

- Weapon placed between jersey barrier and bunker
  - Simulating contact detonation on ground
  - Oriented at 10° from



- Foam/plywood witness panel destroyed
- Significant damage to inside walls of structure

# **DRAFT** Series 2 - Line-of-Fire Denial



- Tremendous number of hits on aluminum panel
- Fragment damage to walls in entryway
- Moderate number of hits on witness panel foam (all secondary debris)

## **Shot 2-4**

- Weapon placed 10' from entrance to bunker
  - Simulating contact detonation on ground
  - Oriented at 10° from normal and at best line-of-fire into bunker
  - Utilized 22 ga. aluminum sheet to man-



# **DRAFT** Series 2 - Line-of-Fire Denial



## **Shot 2-5**

- Weapon placed 1' from entrance to bunker
  - Simulating contact detonation on ground
  - Oriented at 10° from normal and at best line-of-fire into bunker
  - No aluminum witness panel
  - Frag damage to walls in entryway
  - Numerous hits on witness panel foam (secondary debris & small frags)
  - No perforation of plywood

# **DRAFT** Series 2 - Line-of-Fire Denial

- Witness panels placed 2.5' from entrance
- 52 perforations of witness panel plywood in 2-1
- 221 perforations of witness panel plywood in 2-2
- Witness panel destroyed in 2-3
- Moderate fragmentation damage to structure walls and



## **Results**

- Witness panels placed 2.5' from entrance
- Moderate fragmentation damage to entrance walls
  - Numerous secondary debris hits on witness panels which penetrated into foam
- No perforation of plywood



# Series 3 - Aboveground Emplacement

- Experimental objectives:
  - ✓ Validate response of bunker to fragmentation and blast effects of various weapons
- Weapons considered are:
  - ✓ Yugoslavian 82mm mortar
  - ✓ Yugoslavian 120mm mortar, M62P3
  - ✓ Russian 122mm rocket, 9M22Y



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# Series 3 - Aboveground Emplacement

## *Shot 3-1*



- 82mm mortar
- Placed top-center of entrance section
- Direct contact with roof
- Oriented at 55° from normal impact



- No fragment penetration into structure
- Minor shockwave induced back-face spall
- No perforation of witness panel plywood

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# *Series 3 - Aboveground Emplacement*



**Shot 3-1**



**Internal Video**



**External Video**



# Series 3 - Aboveground Emplacement

## **Shot 3-2**



- 120mm mortar
- Placed top-center of 6" barrel
- 2 layers of sandbags placed on roof (approx. 8" total thickness)
- Oriented at 55° from



- No fragment penetration into structure
- Flexural roof response to blast loading
- Approx. permanent deformation

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# *Series 3 - Aboveground Emplacement*



External Video



Internal Video

**Shot 3-2**

# Series 3 - Aboveground Emplacement

## **Shot 3-3**



- No fragment penetration into structure
- Significant flexural roof response to blast loading
- Approx. permanent deformation = 6"-8"
- Back-face spall due to shock and flexural deformation



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# *Series 3 - Aboveground Emplacement*



External Video



Internal Video



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# Series 3 - Aboveground Emplacement

## *Shot 3-4*



- Minor fragment penetration into structure
- Moderate shockwave induced back-face spall
- Approx. 4"x19" breach
- Numerous penetrations into witness panel foam (secondary debris)



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# ERDC Experimental Team

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